General Comments:

This manuscript presents a significantly updated and improved image segmentation approach developed for the All Sky Imager (ASI) deployed at Atmospheric Research Measurement (ARM) user facilities after the retirement of the long-running TSI instrument. The paper is written with clear prose and thorough analysis, and promises to be a highly cited paper, as every future investigation that uses the sky cover or cloud mask output will cite this paper. So it is a timely, relevant, and highly useful publication for the community. I provide ample comments below in my efforts to improve the clarity and relevance of the message in this paper, even though the paper is already of a very high quality and relevance.

Specific Comments:

1. I would like the paper to explicitly provide guidance on how future users of this dataset should use the "uncertainty" information. This comment is motivated by my observation that researchers may tend to ignore or incorrectly use uncertainty metrics. For example, in the discussion of Figure 3c (page 10), it was indicated that the 23.7% confusion of "masked" pixels being classified as "cloudy" pixels was attributed to the "halo" found around artifacts such as the bird, and these pixels are treated as "uncertain." So … is there a way to exclude "uncertain" pixels from the final product (sky cover and cloud mask images)? What would be the benefits and drawbacks from simply excluding all "uncertain" pixels from the final products? (For example, in Figure 2, the cloud masks would convert all of the hatched areas into masked areas.)
2. A sentence or two about the approach to the ASI near-zenith product would be helpful. I was surprised to learn in the caption to Figure 8 that it requires 99% or more of (~5400) pixels within the 5 degrees off-zenith. This didn't make sense to me. How many pixels fall in this 5-deg circle around zenith? Is the ~5400 pixels the product of the pixels in this circle times the number of images? I would assume that a 5-minute running mean was also taken, consistent with the processing for KAZR and CEIL?
3. Since this will probably be the canonical paper for utilization of the ASI data stream, have you considered including a photograph of the instrument? I noticed that one is not included on the ARM ASI instrument page, and it could be nice to see what it looks like! (just a suggestion – your choice.)
4. I would like to know more about how the manually determined training and testing pixels were created. I see now, after carefully reading the paper, that the labeling process is illustrated in Figure 1, but that was not apparent upon my first reading.
   A) This could perhaps be improved by a first sentence in the caption to Figure 1 indicating the main purpose of the figure, before highlighting the distribution of training & testing pixels relative to SZA? Moreover, the histogram could come at the bottom of the figure, because it seems secondary to the labeling boxes in panels b-j. Or the histogram could get moved to a separate figure altogether, perhaps that includes other qualities of the sampled pixels.
   B) I also see that the discussion about manual labelling is located in the paragraph around line 175. It seems odd to me that if "… we attempted to sample the various features in a uniform matter …" then only the distribution of SZA is included in Figure 1. I would expect to also see the distribution of the different classes (clear, thin, etc.), and the

distribution of pixel location (elevation and azimuth angle).
C) (curiosity question) Does the output of this segmentation model appear to be sensitive or insensitive to the sampling and labeling of the manual dataset?

5. I appreciated the discussion about the calibration for the solar zenith and azimuth angle, but I feel that the prose should be more clear, and an equation might facilitate communication, particularly the paragraph around line 110. A) That is: The analytical SZA and azimuth is well known from astronomical factors. I understand that you are using a manual labeling approach to identify the center of the sun location on the image. What is a "denoted image"? When you mention "calculated angles," is this the true SZA? Expected image location of the SZA? Manually determined SZA? Or difference between the expected image location and manually determined location? The same four questions hold for the azimuth angle, of course! I recommend clear and consistent language. A simple equation might help to clarify this discussion significantly. B) Furthermore, it is stated that "the positioning biases characterized for different ARM deployments are robust (e.g. see concentric yellow circles in Figure 1)" and indicates that the "denoted versus calculated angles" have a standard deviation on the order of 1 degree. I'm not sure what "robust" means here – small? Consisitent over time for each deployment? – but examination of Figure 1 shows that the yellow and green circles show significant disagreement in 1b, c, i, and j (4 out of 9), and are noticeably different in all other thumbnail images – e.g. the green circle is not overlapping the yellow circle. I would expect a 1-degree difference to be indistinguishable by eye, so that suggests that I don't understand something fundamental about the "denoted versus calculated" angles. Please clarify!

Technical Corrections:

6. Line 51: There is a citation to (ASI-16) that I cannot find in the bibliography. Is there a publication that describes the fundamentals of the ASI deployed at the ARM sites, such as image size (pixel dimension), image capture frequency, dynamic range (presumably 256 bit), and anything else? If not, then this publication could serve this need!
7. Line 85-90. This indicates that the image center is found by the black circle in the ASI images. Yet the black circle must be set by the imaging rig, right? Because the world doesn't become black below the horizon. So what makes us think that the center of this black circle represents true zenith?
8. Lines 100-105. I found myself wondering about possible barrel distortion here, and you discuss it around lines 135-140. Consider moving the lens distortion discussion to this section. (optional – your choice!)

Figure 1

9. The axis labels are too small to read, including the legend in 1a and the SZA & AZ annotations in each thumbnail.
10. The colors of the boxes are not at all clear from the text description in the caption (orange, yellow, purple and brown). Could you please include a legend with the colored lines, because I cannot tell them apart in the images!

11. See my comments above suggesting that the histogram comes at the bottom of the image, the caption begins with an orientation for the reader, and/or the histogram gets moved to a separate figure that contains histograms for other properties as well.
12. Even with a legend with line color, it is tremendously hard to see the boxes and colors. Could this image be enlarged to full-page size?
13. I am curious – where is "North" in these images? I would expect it towards the top of the image, with "East" towards the right, but the azimuth angles don't support that assumption. Could you please add a compass rose or North arrow for clarification?

Figure 2

14. Again, the font size for the legends in the "cloud masks," the colorbar labels, and the image titles are too small to read!
15. An image such as this begs for a "truth" column to the right of the segmented image to enable a discussion of the spatial patterns that have been accurately or inaccurately labeled. Which leads me to wonder: what would be the most perfect, "true" segmentation result for these four images? (!)

16. Table 1: is the third column needed?
17. Para near line 175: Perhaps consider adding the geographic context (e.g. Tasmania, Alabama, US) for the field sites that don't include the geographic location, and also for the CuORAGE site around line 199. (suggestion)
18. A citation or additional information about the root-sum-square analysis would be helpful

Figure 3.

19. Avoid red font on a blue background! I suggest a grayscale background with black text on the non-diagonal cells, and white text on the diagonal cells.
20. Fix the massive size of (a), (b), and (c).

21. Line 244: theta_i1, and theta_i2 should not be the SOLAR zenith angles, but perhaps the pixel zenith angles? Also, the "vertical edges" of a pixel is not clear – do you really mean the y-axis limits (vertical)? Wouldn't a conversion to radial coordinates make more sense? Otherwise with "vertical" pixel zenith angle for a pixel at y ~ 800 would be identical. (using the pixel counts from Figures 1 & 2)
22. Line 245. I am curious – if the N_valid does not include "uncertain" pixels, then presumably neither does N_cld. So I wonder then where the "uncertainty" comes from, for example in Figure 8, where it appears to be around 10-20%?
23. Line 282. Sentence beginning "In addition …" The previous sentence discussed the cloud cover around sunset, but this sentence appears to discuss the morning, Please provide a transition for the reader.

24. Line 285 and the thumbnail sky image in Figure 5 at 14:00: You cite "the challenge in even manually interpreting …" It is entirely unclear from the print copy of this paper what is going on in the thumbnail at 14:00! It appears to be a clear (blue) sky? Yet the ceilometer reads 100% cloud cover (< 7 km), and the text indicates low clouds. Could the experts please clarify what the "true" sky cover is like in this case, for example?

Figure 5:

25. Again I find myself wondering about north, since the sun appears to set in the southeast.
26. The text discusses SZA = 80-deg. Could you indicate when that occurs in the figure? (e.g. civil twilight etc., or time of day?)
27. It might be nice to include lines that connect each image thumbnail to the time of its capture, since they don't all appear immediately under their image time. I think this would help you tell your story.
28. Any chance you could enlarge the font size for the axis tick labels and axis labels? (I understand that the legend size is limited!) That said – please reduce the font size for the thumbnail image times!
29. Consider adding the ASI-determined cloud cover (f) for each thumbnail.

30. Full year analysis: I am curious about times when the thin clouds (presumably higher altitude) might be occluded by the lower, thicker clouds. I'm not sure if this is relevant or important, though, given the snapshot-nature of this data presentation.
31. Full year analysis: a number of cloud climatologies have been done at the SGP site. Is there any way to compare this one-year output to any of those published datasets?

Figure 6 (all optional suggestions for your consideration)

32. You might consider a different color choice, so "thin" corresponds to a lighter color, and "thick" to a darker color for easier interpretation.
33. I would also recommend text labels under each shaded region reading, for example "thick," "thin," and "intermediate" for easier interpretation.
34. I'm sure you carefully designed the figure, but I would have expected the "thick" category to be on the bottom, partially because it is the primary ASI observation since it tends to occur due to lower clouds. Also, when "thick" is high, I would expect more "thin" clouds to be occluded, indicating that the shaded regions should be dependent upon the lower region.

Figure 7

35. Again, please reduce the font size for (a), (b) etc.
36. I find the color contrast in Figure 7b challenging, between the 25 < CC < 50 and the 50 < CC < 75 conditioning. Perhaps a different hue?
37. In figure 7c, I'm curious about the mostly clear images. Are there any images with CC = 0%? If they have one pixel that is "thin," does it fall in the "thin dominated" category? I

wonder if a lower limit on CC is appropriate here, to help account for clear sky images in which no cloud type is dominated?

38. Consider including in the caption the data analyzed: presumably the SGP images from 2024?

39. Line 372: “(or clear sky pixels as clear for that matter, see Figure 3)” This is not apparent to me! The clear classification (horizontal row – true label) looks good in image 3a!
40. Line 375: I feel that this final sentence of this paragraph is an important key conclusion of your paper! “the dominating cloud type per scene might be the best predictor for cloud detection algorithm consistency.” Consider highlighting this in the abstract & conclusion? Unfortunately, the second clause to this sentence is not clear to me (“and emphasize the model performance …”)
41. Line 381: regarding ASI solar flaring, perhaps refer to Figure 1, panels c-i?

Figure 8:

42. Does this figure again analyze the 2024 observations from SGP?
43. In the bar chart, does “Number of samples” correspond to images? Pixels? 5-minute observations?
44. I also want to make sure that the x-axis label for the bar chart should truly
45. Line 411 in the caption to Figure 8: close the parentheses after (see Section 3.1).

46. Line 447: “gamma configurations” is not clear.